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INSTANT OCTAL ACCOUNTING:

BYPRODUCT OF FOREST GROWTH STUDIES

By

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ABSTRACT: Describes a research accounting program developed as a byproduct of forest mensuration research for use on an IBM 7090 computer. It arrays thousands of unsorted items in a few seconds; accumulates expenditures, obligations, and transfers by account within fund for each responsible individual; and prints subtotals, balances, and an arrayed list of component items.

Anyone studying the field of forest growth and inventory is soon aware of its close relationship to the field of accounting. There are many tree classes whose growth must be kept separate, corresponding to separate funds or accounts. Survivor growth, in-growth from below, harvest, and negative growth (mortality) correspond to interest, deposits or withdrawals, and so forth. Forest mensurationists and accountants both require detailed reports of current change as well as periodic aggregate balance sheets. The similarity between the two has made it feasible to slightly modify a computer program originally developed to handle a mensurational problem in forest inventory, the resultant by-product being an easy-to-use program applicable to much more universal problems of money management. The program is illustrated here by application to problems that often vex scientists: a time lag, an awkward format, or uncertainties in their organizations' current financial statements.

Scientists need timely, complete knowledge to avoid under- or over-use of the multiple drawing accounts that complicate most institutional research financing. Even if sources of funds are not complex, higher echelons may have limited total costs that can be incurred for specified projects or purposes, regardless of the fact that costs will be paid from several funds that could physically support much heavier expenditures. Often knowledge of what items have been included in a statement is as important as the total balance shown.

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The systems of bookkeeping designed by directors, controllers, and auditors provide postmortem clues to organizational inefficiency or individual dishonesty. But few systems are designed to give scientists either adequate or current information on fund balances, account charges, and component transactions so necessary for efficient conduct of research projects. As a lead editorial in Science[1] indicates, the problem has ceased to be purely academic.

The author has long envisioned a simple system employing one printed-and-punched card per item that would handle obligations, expenditures, reconciliations, and transfers classified by individual responsible, fund affected, and account charged. To provide today's answer today, such a system cannot depend on pen-and-ink posting of distributions, tedious card-shuffling in old-fashioned sorters, or tabulation by computers that require specially arranged data. Luckily, the amazing capability of the modern binary computer makes possible a much faster and less arduous approach.

Advantages of Octal Codes

A glance at existing fiscal coding usually indicates considerable departure from the basic principles of information retrieval coding--apples and oranges sometimes share a common coding field, while different classes of oranges may wastefully occupy separate fields. Obviously, this arrangement needs rectification to take advantage of new high-speed equipment and to supply information efficiently.

This is the golden moment to shift from decimal to octal coding. As any scientist knows, an octal code differs from a decimal code merely by not using the digits 8 and 9. Octal codes are much more compact and efficient than decimal codes for binary sorting, which is the quickest of all sorts. Such magnitudes as dollars and document numbers can remain decimal. Just to indicate the astonishing superiority of binary sorting over conventional decimal sorting, a binary sort in the memory of a binary computer will completely array from 500 to 1,000 cards per second on 72 octal digits taken in any prescribed sequence without disarraying whatsoever the physical order of the cards fed into it.

Input can be unsorted, chronological, or arbitrarily numbered in sequence; all input is usually transferred to magnetic tape to reduce the time needed for entry into the computer. The quickest sorting is accomplished electronically in the core memory of the computer. Records can exceed a card of 72 columns by almost any amount as long as length is constant.

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[1] D.[ael] W.[olfle]. Whose responsibility? Science 138:7, 1962.

Fiscal Classifications

Once a code has been adopted, the various points of view from which each transaction will be classified, scanned, and retrieved or accumulated should be analyzed. Organizations differ as to the money-management classes they recognize. But such classes can generally be lumped into four more or less independent categories which, for the purpose of this paper, have been given the following code names: (a) WHOSE, (b) FUNDS, (c) ACCOUNTS, and (d) WHY.

The WHOSE category answers the question "WHOSE is the responsibility for avoiding overdrafts on a given source of funds, or for avoiding expenditures exceeding prescribed limits?" A 6-digit octal code differentiates between 262,143 people arranged hierarchically, if desired.

The FUNDS category considers: "What broader FUNDS or assets are increased or decreased by an expenditure, obligation, or transfer?" Ordinarily another 6-digit octal number is enough to identify this item although sometimes it may be further particularized by a device described below.

The ACCOUNTS category answers the question: "What cost ACCOUNTS or liabilities are affected?" Usually (but not always) accounts are deemed to have existence independent of the funds which are used to pay the costs. Sometimes a single scientist employs them merely to keep track of how he spends a single fund; such accounts have no existence apart from that fund and contain no money--only negative sums or costs pertaining to a single fund controlled by a single individual. Sometimes negative sums or costs withdrawn from several funds controlled by one or more individuals are pooled into a single account; such accounts exist independently of the sources of funds. Finally, some accounts actually are analogs of separate bank accounts into which money is transferred that can only be spent for a specific objective or project. In such cases the FUNDS and the cost ACCOUNTS are identical, except that the amount transferred into the FUNDS and ACCOUNTS must be subtracted from the balance to get true negative cost.

The author devised the following system to recognize all three types of ACCOUNTS within a single 6-digit octal field. A negative account which has no existence independent of a particular WHOSE and FUNDS can be identified by from one to three low-order octal digits. A negative account that has independent existence will be denoted by four or five octal digits. No money is ever transferred into these negative accounts--it always is transferred to the WHOSE FUNDS as a whole (the ACCOUNTS field of such transfers is zero or blank).

Positive ACCOUNTS that actually have money transferred into them for special purposes (sometimes from several sources) also exist independently of any particular fund, but they will be denoted by six octal digits.

Thus, this last kind of account will give coded WHOSE FUNDS ACCOUNTS the appearance of a single 18-digit octal field, while the two others will have ACCOUNTS separated from WHOSE FUNDS by from one to five blanks. The positive account has money transferred directly into it, not into any zero account. A further refinement might be to reserve 6-digit octal numbers of 400,000 and larger and 5-digit octal numbers from 40,000 to 77,777 for ACCOUNTS that involve two or more WHOSE or two or more FUNDS.

Regardless of whether the above system is used, six octal digits should be ample to distinguish among ACCOUNTS.

The fourth independent category of fiscal information is the budgetary classification WHY (reasons such as food, clothes, and entertainment in personal budgeting). It is mainly important in planning or justifying future expenditures, or in analyzing what might have been wrong with past expenditures. Though a valuable tool, WHY is usually only needed at the beginning or end of each fiscal year. It does not need to be incorporated into frequent up-to-the-minute reports such as are needed in current money management.

However the author has provided a space for four octal digits of WHY information so that it can be shown if desired. It will affect the sorting and will be printed in the item-by-item listing, but it will not control any subtotals. Two octal digits preceding this WHY information are devoted to "housekeeping" chores. The "housekeeping" field is left blank on "carried forward" cards and on "separator" cards, punched 01 for TRAN items, punched 03 for PAID or OWED items, and punched 05 for numerical correction items. These terms are explained below.

Continuity, Type of Transaction, and Separators

A useful financial report should juxtapose prior "carried forward" totals and updated "current" totals separately for three categories of monetary transactions: actual expenditures, firm obligations, and transfers (executive fiats). Let us call these elements PAID, OWED, TRAN. In the printed report, if followed by an FM (abbreviation for "from") and a date, subtotals of these elements are carried forward. If followed by a TO and a current date, they are updated subtotals, and they will also be automatically punched out on a new card for each individual ACCOUNT since this will be needed as a basis for subsequent reports. Updated WHOSE FUNDS ACCOUNTS subtotals will also be algebraically combined into the sum of TRAN minus PAID minus OWED and will be printed immediately below and to the right, labeled ACCOUNT SUBTOTAL. All component account subtotals are summed for each WHOSE FUNDS entry and printed underneath the last ACCOUNT SUBTOTAL labeled ALLOTTEE FUNDFUNC BALANCE, with the code for the particular WHOSE FUNDS and the current date preceding it.

A separator card can be punched to head each WHOSE FUNDS, if desired. It should have the appropriate WHOSE FUNDS punched in the first 12 columns, zeros punched in columns 36, 48, 60, and minus signs punched in columns 61 through 80.

Component Item Listing and Check Totals

When the last ALLOTTEE FUNDFUNC BALANCE has been printed, every item that brought about a change from the previous report will be listed, arrayed by WHOSE FUNDS ACCOUNTS. This listing helps scientists know what items are included (or not included), whether the correct final cost is known or only the obligation estimate, and whether items are out of place, wrongly coded, wrongly punched, etc. Within each account, items are arrayed as follows for convenience: carried forward, items involving TRAN only, PAID items with a positive sign arrayed by magnitude of OWED amount regardless of sign, PAID items with a negative sign arrayed by magnitude of OWED amount regardless of sign, and items involving a numerical correction. Columns 61 through 72 identify the document which the card reflects. Columns 73 through 80 can be used for card file mnemonics, but they do not enter the computer.

Finally, grand totals of carried forward (prior report totals) PAID, OWED, TRAN are shown, followed by grand totals for the current report PAID, OWED, TRAN (including prior report totals) and the algebraic sum of these (the grand balance).

The availability of previous report totals, grand totals, etc. facilitates elaborate or simple checking.

An example of how the report looks is appended (appendix 1). As many as 4,000 cards can be input at a time. The limit could be infinity if tape sorts were employed; alternatively, larger inputs can be broken down into sets of not more than 4,000, and the card output from one set used as the carried forward cards for the next set, etc. Different order of sorting (without repunching the cards) is quite feasible, but the present order is the natural order for fund accounting by responsible individuals. This is the information needed most urgently and frequently.

Format for input is shown in appendix 2. A guess as to number of data cards involved (preceded by a minus sign) is needed on the initial card (the control card). The computer subsequently will accurately count the cards and print your guess (negative) and the correct count (positive) at the top of each page of the report.

How to Handle OWED and PAID Items

Allottees can set up their own local account numbers as needed (2 to 777 for each fund) if they also note it on each obligation document. Higher echelons should control the cross-fund, cross-individual, and cross-hierarchy account numbers above 777 octal. Account 0 (zero)

in each WHOSE FUNDS should always be reserved for input and output by transfer, and account 1 (one) in each WHOSE FUNDS should always be reserved for miscellaneous expenditures.

As explained above; accounts will ordinarily not have money transferred into them (funds will be placed in local account zero of the WHOSE FUNDS), and disbursing will usually be from account zero also, though charged to a particular account. Such accounting will reflect correct ALLOTTEE FUNDFUNC BALANCES, but all ACCOUNT SUBTOTALS (except zero) that are components will usually be negative. This technique provides many figures needed administratively yet does not complicate disbursing. It is particularly applicable to keeping track of expenditure limitations that are independent of funds available.

Finally, the method of achieving the transition from OWED to PAID needs a little explanation. When an obligation is incurred, an appropriate card is made out with the PAID column left blank. When this obligation is paid, the card is duplicated up to the PAID field, the exact PAID amount is entered on the duplicate card, a minus sign is punched on the duplicate card just ahead of the digits in the OWED field, and finally the rest of the card is duplicated (including the OWED amount now preceded by a minus sign). If the obligation was incurred during the current reporting period and a zero was not punched in PAID at obligation time, a zero should then be punched in the PAID field of the original obligation card, and both cards will be used in the current report. If the obligation was incurred in and covered by a previous report, only the duplicate card (with its positive PAID field and negative OWED field) will be used in the current report, of course. If an obligation reported in a previous report is cancelled, the amount to be punched in the duplicate PAID field is zero, of course.

When a PAID item has no previous obligation card, a zero should be punched in the OWED field. All correction cards and TRAN items should also have zero punched in unused PAID and OWED fields.

The net result of this procedure will be that no minus zeros (indicating a blank field) should occur in the OWED field, while any minus zeros in the PAID field will indicate unpaid items, if the field has been left blank.

An obvious alternative procedure would be to punch initially each OWED transaction on a scarlet "tickler file" card and punch zero in the PAID field. This entire card would then be duplicated for use in the current report. After payment of the obligation, the scarlet tickler file card would be conveniently available for duplication, with two changes: the exact PAID amount would be inserted in place of zero, and a minus sign would precede the originally OWED amount. The scarlet tickler file card should then be destroyed, so that the tickler file would represent only currently unpaid obligations. Thus all PAID transactions could be handled identically whether obligated in the current period or not. Also, the need to search and rehandle actual component

items of reports would be eliminated. An incidental benefit would be the attention focused on items remaining unpaid for any great lengths of time. Items obligated and paid in the same report period would still be easily recognizable in the listing, where the negative of the OWED amount would appear immediately below the same positive OWED amount. No minus zeros (for blank fields) would ever appear in the PAID or OWED columns if this system were used. But any OWED amount not paired with its own negative immediately below must be an unpaid obligation.

The present system uses floating point arithmetic, and so it will handle items up to $999,999.99 properly (a penny or so may disappear through rounding numerous items). Now that FORTRAN 4 is available, a slight program modification would allow using integer arithmetic involving 35 binary bits. This change would permit handling positive amounts up to $343,597,383.67 (negative amounts to one digit less). Also, the integer arithmetic would be slightly faster, and amounts would check to the penny, because no rounding takes place. Dollar accounting or double-precision floating point arithmetic can be used to increase the maximum magnitude permissible if desired.

An entire report involving 4,000 cards, or less, (completely unsorted) should not take more than a minute or so. The 98-item example in appendix 1 took only 30 seconds, and even with 4,000 items only a few more seconds would be involved. If the cards are punched currently so that they are up to date at 4:30 p.m. on the final Friday of some period of interest, they can be dropped in the monitor of some suitable binary computer (an IBM 7090 was used by the author), and the full output will be available almost instantaneously, without any concern about the mechanics of sorting or tabulation. If an error glares out from the listing, correct the card and rerun the report--even at commercial rates each report will cost less than five dollars. Such computer time is available at a number of commercial installations in the larger cities.

Implementation

If you are convinced of the merits of this speedy and simple accounting system, how can it be implemented? Three different levels of implementation are possible.

If you are high enough on the totem pole or persuasive enough, you can adopt it in toto, establish an institutionwide coding system, and use it for all accounting purposes. You will then want your programers to make several slightly different versions of the main FORTRAN program ACT (and its FAP subroutine XTB) so that at least three other reports (more as desired) can alternatively be produced with the same lightning speed, but with less frequency. These will be reports on FUNDS ACCOUNTS WHOSE, on ACCOUNTS FUNDS WHOSE, and on WHY WHOSE FUNDS.

If your authority or persuasiveness is inadequate, your fiscal group may still wish to adopt the system for obligations (in lieu of hand-kept obligation registers, etc.), and with a little extra work you or your staff could periodically incorporate actual disbursements into it. This can be accomplished most efficiently directly from the fiscal documents as they clear control points, without the need for "aprons" or separate coding sheets.

Finally, you can do it all yourself and eliminate whatever manual or "cuff" methods you are now forced to employ to keep up with your money. In this last situation, your fiscal group could be of great help if in addition to the usual sequential voucher record, it would post actual PAID amounts either on sequential files of obligation documents, or on such handwritten obligation registers as they continue to keep.

The preceding discussion has been aimed at project scientists not now provided with adequate or timely fiscal information. But the system is equally applicable (with some obvious and simple modifications) to administrators everywhere in operational, managerial, or business jobs if they see a need to improve the timeliness or adequacy of their fiscal reports.

Very large or complex organizations may need two cards per item, may need a tape-sort rather than a core-sort subroutine, and may control tabulation by separator cards or on groups of octal digits other than 6 to 12 (however, these are the most efficient fields for 36-bit fixed-word-length binary machines with a repertoire of half-word commands). These variations are minor details. The basic machine programs given in appendix 3 are easily modified or tailored to an individual organization's needs.

Progressive organizations may be in a position to create paper-tape or punched-card records simultaneously with the typing of payrolls, vouchers, and purchase orders (using a typewriter that simultaneously punches paper tape); they may further be willing to employ leased-wire or micro-wave facilities to transmit the magnetic-tape counterpart of such input and subsequently processed output to and from large binary computers too remote to provide prompt processing otherwise. These approaches are already widely employed by those eager to pay yesterday's obligations today, or to provide today's informational needs today.

APPENDIX 1

Illustration of Output for Instant Octal Accounting

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   PSWFES ALLOTTEE-FUND-ACCOUNTING      12-31-62      -99    98 PAGE   1
WHOSE FUNDS ACCTS                 PAID        OWED       TRAN  BAL,SUB,DOC*

250201307511      0               0.          0.         0.  ------------
250201307511      0               0.          0.      7655.00 TO 12-31-62
                                              ACCOUNT SUBTOTAL      7655.00

250201307511      1               7.17       71.40       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL       -78.57

250201307511      2             295.50      350.75       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL      -646.25

250201307511      3             526.57       17.52       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL      -544.09

250201307511              12-31-62 ALLOTTEE FUNDFUNC BALANCE        6386.09

250202307511      0               0.          0.         0.  ------------
250202307511      0               0.          0.      8000.00 FM  9-30-62
250202307511      0               0.          0.     22527.77 TO 12-31-62
                                              ACCOUNT SUBTOTAL     22527.77

250202307511      1              35.50     3000.00       0.   FM  9-30-62
250202307511      1            3035.50     7112.25       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL    -10147.75

250202307511      2              25.00        0.         0.   FM  9-30-62
250202307511      2             520.15      456.25       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL      -976.40

250202307511              12-31-62 ALLOTTEE FUNDFUNC BALANCE       11403.62

250203307511      0               0.          0.         0.  ------------
250203307511      0               0.          0.       712.50 FM  9-30-62
250203307511      0               0.          0.       712.50 TO 12-31-62
                                              ACCOUNT SUBTOTAL       712.50

250203307511 52501                1.20      565.00       0.   FM  9-30-62
250203307511 52501              251.20      365.00       0.   TO 12-31-62
                                              ACCOUNT SUBTOTAL      -616.20

25020330751124000 1               0.          0.      5000.00 FM  9-30-62
25020330751124000 1               0.         20.00    5000.00 TO 12-31-62
                                              ACCOUNT SUBTOTAL      4980.00

25020330751141260 1               0.          0.    555555.00 FM  9-30-62
25020330751141260 1               0.      22222.00    555555.00 TO 12-31-62
                                              ACCOUNT SUBTOTAL    533333.00

250203307511              12-31-62 ALLOTTEE FUNDFUNC BALANCE      538409.30
```

WHOSE FUNDS	ACCTS	PAID	OWED	TRAN	BAL,SUB,DOC#
250207724511	0	0.	0.	0.	----------
250207724511	0	0.	0.	7000.00	FM 9-30-62
250207724511	0	0.	0.	7000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		7000.00
250207724511	1	0.	400.00	0.	TO 12-31-62
			ACCOUNT SUBTOTAL		-400.00
250207724511		12-31-62 ALLOTTEE FUNDFUNC BALANCE			6600.00
250210726511	0	0.	0.	0.	----------
250210726511	0	0.	0.	2000.00	FM 9-30-62
250210726511	0	0.	0.	2000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		2000.00
250210726511	1	0.	60.00	0.	TO 12-31-62
			ACCOUNT SUBTOTAL		-60.00
250210726511		12-31-62 ALLOTTEE FUNDFUNC BALANCE			1940.00
250302307513	0	0.	0.	0.	----------
250302307513	0	0.	0.	500.00	FM 9-30-62
250302307513	0	0.	0.	500.00	TO 12-31-62
			ACCOUNT SUBTOTAL		500.00
250302307513		12-31-62 ALLOTTEE FUNDFUNC BALANCE			500.00
250406307541	0	0.	0.	0.	----------
250406307541	0	0.	0.	0.	TO 12-31-62
			ACCOUNT SUBTOTAL		0.
250406307541412601		0.	0.	400.00	FM 9-30-62
250406307541412601		0.	100.00	400.00	TO 12-31-62
			ACCOUNT SUBTOTAL		300.00
250406307541		12-31-62 ALLOTTEE FUNDFUNC BALANCE			300.00
250502307521	0	0.	0.	0.	----------
250502307521	0	0.	0.	777777.77	FM 9-30-62
250502307521	0	0.	0.	777777.77	TO 12-31-62
			ACCOUNT SUBTOTAL		777777.77
250502307521 52501		0.	100.00	0.	FM 9-30-62
250502307521 52501		102.50	0.	0.	TO 12-31-62
			ACCOUNT SUBTOTAL		-102.50
250502307521		12-31-62 ALLOTTEE FUNDFUNC BALANCE			777675.27

PSWFES ALLOTTEE-FUND-ACCOUNTING 12-31-62 -99 98 PAGE 3

WHOSE FUNDS ACCTS		PAID	OWED	TRAN	BAL,SUB,DOC#
250602307701	0	0.	0.	0.	----------
250602307701	0	0.	0.	2000.00 FM	9-30-62
250602307701	0	0.	0.	2000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		2000.00
250602307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			2000.00
250603307701	0	0.	0.	0.	----------
250603307701	0	0.	0.	3000.00 FM	9-30-62
250603307701	0	0.	0.	3000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		3000.00
250603307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			3000.00
250604307701	0	0.	0.	0.	----------
250604307701	0	0.	0.	4000.00 FM	9-30-62
250604307701	0	0.	0.	4000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		4000.00
250604307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			4000.00
250605307701	0	0.	0.	0.	----------
250605307701	0	0.	0.	5000.00 FM	9-30-62
250605307701	0	0.	0.	5000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		5000.00
250605307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			5000.00
250606307701	0	0.	0.	0.	----------
250606307701	0	0.	0.	6000.00 FM	9-30-62
250606307701	0	0.	0.	6000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		6000.00
250606307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			6000.00
250607307701	0	0.	0.	0.	----------
250607307701	0	0.	0.	7000.00 FM	9-30-62
250607307701	0	0.	0.	7000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		7000.00
250607307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			7000.00
250610307701	0	0.	0.	0.	----------
250610307701	0	0.	0.	10000.00 FM	9-30-62
250610307701	0	0.	0.	10000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		10000.00
250610307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			10000.00

PSWFES ALLOTTEE-FUND-ACCOUNTING WHOSE FUNDS ACCTS		PAID	12-31-62 OWED	-99 TRAN	98 PAGE 4 BAL,SUB,DOC#
250611307701	0	0.	0.	0.	----------
250611307701	0	0.	0.	11000.00	FM 9-30-62
250611307701	0	0.	0.	11000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		11000.00
250611307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			11000.00
250612307701	0	0.	0.	0.	----------
250612307701	0	0.	0.	12000.00	FM 9-30-62
250612307701	0	0.	0.	12000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		12000.00
250612307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			12000.00
250613307701	0	0.	0.	0.	----------
250613307701	0	0.	0.	13000.00	FM 9-30-62
250613307701	0	0.	0.	13000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		13000.00
250613307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			13000.00
250614307701	0	0.	0.	0.	----------
250614307701	0	0.	0.	14000.00	FM 9-30-62
250614307701	0	0.	0.	14000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		14000.00
250614307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			14000.00
250615307701	0	0.	0.	0.	----------
250615307701	0	0.	0.	15000.00	FM 9-30-62
250615307701	0	0.	0.	15000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		15000.00
250615307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			15000.00
250616307701	0	0.	0.	0.	----------
250616307701	0	0.	0.	16000.00	FM 9-30-62
250616307701	0	0.	0.	16000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		16000.00
250616307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			16000.00
250617307701	0	0.	0.	0.	----------
250617307701	0	0.	0.	17000.00	FM 9-30-62
250617307701	0	0.	0.	17000.00	TO 12-31-62
			ACCOUNT SUBTOTAL		17000.00
250617307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			17000.00

WHOSE FUNDS ACCTS		PAID	OWED	TRAN BAL,SUB,DOC#	
250620307701	0	0.	0.	0.	----------
250620307701	0	0.	0.	20000.00 FM	9-30-62
250620307701	0	0.	0.	20000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		20000.00
250620307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			20000.00
250621307701	0	0.	0.	0.	----------
250621307701	0	0.	0.	21000.00 FM	9-30-62
250621307701	0	0.	0.	21000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		21000.00
250621307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			21000.00
250622307701	0	0.	0.	0.	----------
250622307701	0	0.	0.	22000.00 FM	9-30-62
250622307701	0	0.	0.	22000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		22000.00
250622307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			22000.00
250623307701	0	0.	0.	0.	----------
250623307701	0	0.	0.	23000.00 FM	9-30-62
250623307701	0	0.	0.	23000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		23000.00
250623307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			23000.00
250624307701	0	0.	0.	0.	----------
250624307701	0	0.	0.	228000.00 FM	9-30-62
250624307701	0	0.	0.	228000.00 TO	12-31-62
			ACCOUNT SUBTOTAL		228000.00
250624307701		12-31-62 ALLOTTEE FUNDFUNC BALANCE			228000.00

PSWFES ALLOTTEE-FUND-ACCOUNTING WHOSE FUNDS ACCTS	PAID	12-31-62 OWED	-99 TRAN	98 PAGE 6 BAL,SUB,DOC*
25020130751100000000000	0.	0.	0.	----------
25020130751100000003010000	0.	0.	7655.00	OA*26-63
25020130751100000001030025	2.96	0.	-0.	IMP FUNDS
25020130751100000001030025	4.21	0.	-0.	IMP FUNDS
25020130751100000001030025	-0.	16.40	-0.	P*21463-73
25020130751100000001030025	-0.	55.00	-0.	P*2130963
25020130751100000002030021	67.50	0.	-0.	TV*211975
25020130751100000002030021	228.00	0.	-0.	TV*211062
25020130751100000002030021	-0.	83.75	-0.	A*3648162
25020130751100000002030021	-0.	267.00	-0.	A*3648163
25020130751100000003030025	0.	116.80	-0.	P*211363-52
25020130751100000003030025	202.30	-116.80	-0.	P*211363-52
25020130751100000003030025	0.	145.00	-0.	P*211363-52
25020130751100000003030025	133.70	-145.00	-0.	P*211363-52
25020130751100000003030025	0.	146.00	-0.	P*211363-52
25020130751100000003030025	190.57	-146.00	-0.	P*211363-52
25020130751100000003030025	-0.	17.52	-0.	P*211363-52
25020230751100000000000	0.	0.	0.	----------
25020230751100000000000	0.	0.	8000.00	FM 9-30-62
25020230751100000003010000	0.	0.	15000.00	OA*15-63
25020230751100000003010000	0.	0.	-500.00	OA*22-63
25020230751100000003050000	0.	0.	27.77	CORR*PSW147
25020230751100000001000000	35.50	3000.00	0.	FM 9-30-62
25020230751100000001030000	3000.00	-3000.00	-0.	P*214763
25020230751100000001030000	-0.	12.25	-0.	A*3456321
25020230751100000001030000	-0.	100.00	-0.	P*211263
25020230751100000001030000	-0.	2000.00	-0.	P*212363
25020230751100000001030000	-0.	5000.00	-0.	P*213263
25020230751100000002000000	25.00	0.	0.	FM 9-30-62
25020230751100000002030000	63.00	0.	-0.	IMP FUNDS
25020230751100000002030000	75.00	0.	-0.	V*211146
25020230751100000002030000	0.	125.25	-0.	P*214863
25020230751100000002030000	100.15	-125.25	-0.	P*214863
25020230751100000002030000	0.	200.00	-0.	P*218663
25020230751100000002030000	257.00	-200.00	-0.	P*218663
25020230751100000002030000	-0.	56.00	-0.	P*217363
25020230751100000002030000	-0.	400.25	-0.	P*219763
25020330751100000000000000	0.	0.	0.	----------
25020330751100000000000000	0.	0.	712.50	FM 9-30-62
25020330751105250100000	1.20	565.00	0.	FM 9-30-62
25020330751105250103000	250.00	-200.00	-0.	P*2110363
25020330751124000100000	0.	0.	5000.00	FM 9-30-62
25020330751124000103000	-0.	20.00	-0.	P*213763
25020330751141260100000	0.	0.	555555.00	FM 9-30-62
25020330751141260103000	-0.	22222.00	-0.	P*217963
25020772451100000000000	0.	0.	0.	----------
25020772451100000000000	0.	0.	7000.00	FM 9-30-62
25020772451100000001030000	-0.	400.00	-0.	P*215063
25021072651100000000000	0.	0.	0.	----------
25021072651100000000000	0.	0.	2000.00	FM 9-30-62
25021072651100000001030000	-0.	60.00	-0.	P*216863
25030230751300000000000	0.	0.	0.	----------
25030230751300000000000	0.	0.	500.00	FM 9-30-62

```
25040630754100000000000000        0.          0.          0.  ----------
25040630754141260100000000        0.          0.     400.00 FM  9-30-62
25040630754141260103000000       -0.        100.00       -0.  P*212363
25050230752100000000000000        0.          0.          0.  ----------
25050230752100000000000000        0.          0.  777777.77 FM  9-30-62
25050230752105250100000000        0.        100.00       0.   FM  9-30-62
25050230752105250103000000      102.50     -100.00       -0.  A*2345671
25060230770100000000000000        0.          0.          0.  ----------
25060230770100000000000000        0.          0.    2000.00 FM  9-30-62
25060330770100000000000000        0.          0.          0.  ----------
25060330770100000000000000        0.          0.    3000.00 FM  9-30-62
25060430770100000000000000        0.          0.          0.  ----------
25060430770100000000000000        0.          0.    4000.00 FM  9-30-62
25060530770100000000000000        0.          0.          0.  ----------
25060530770100000000000000        0.          0.    5000.00 FM  9-30-62
25060630770100000000000000        0.          0.          0.  ----------
25060630770100000000000000        0.          0.    6000.00 FM  9-30-62
25060730770100000000000000        0.          0.          0.  ----------
25060730770100000000000000        0.          0.    7000.00 FM  9-30-62
25061030770100000000000000        0.          0.          0.  ----------
25061030770100000000000000        0.          0.   10000.00 FM  9-30-62
25061130770100000000000000        0.          0.          0.  ----------
25061130770100000000000000        0.          0.   11000.00 FM  9-30-62
25061230770100000000000000        0.          0.          0.  ----------
25061230770100000000000000        0.          0.   12000.00 FM  9-30-62
25061330770100000000000000        0.          0.          0.  ----------
25061330770100000000000000        0.          0.   13000.00 FM  9-30-62
25061430770100000000000000        0.          0.          0.  ----------
25061430770100000000000000        0.          0.   14000.00 FM  9-30-62
25061530770100000000000000        0.          0.          0.  ----------
25061530770100000000000000        0.          0.   15000.00 FM  9-30-62
25061630770100000000000000        0.          0.          0.  ----------
25061630770100000000000000        0.          0.   16000.00 FM  9-30-62
25061730770100000000000000        0.          0.          0.  ----------
25061730770100000000000000        0.          0.   17000.00 FM  9-30-62
25062030770100000000000000        0.          0.          0.  ----------
25062030770100000000000000        0.          0.   20000.00 FM  9-30-62
25062130770100000000000000        0.          0.          0.  ----------
25062130770100000000000000        0.          0.   21000.00 FM  9-30-62
25062230770100000000000000        0.          0.          0.  ----------
25062230770100000000000000        0.          0.   22000.00 FM  9-30-62
25062330770100000000000000        0.          0.          0.  ----------
25062330770100000000000000        0.          0.   23000.00 FM  9-30-62
25062430770100000000000000        0.          0.          0.  ----------
25062430770100000000000000        0.          0.  228000.00 FM  9-30-62

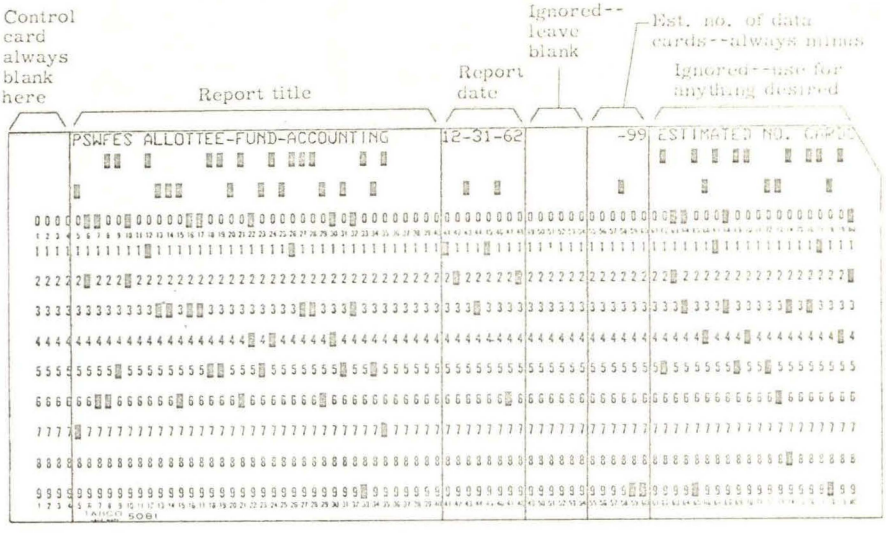
PRIOR SUMS ,                     61.70     3665.00  1805945.27
TOTAL SUMS ,12-31-62           4738.59    31175.17  1828128.03
FINAL BAL. ,12-31-62                          .    1792214.27 END OF RUN
```

APPENDIX 2

Illustration of Input for Instant Octal Accounting

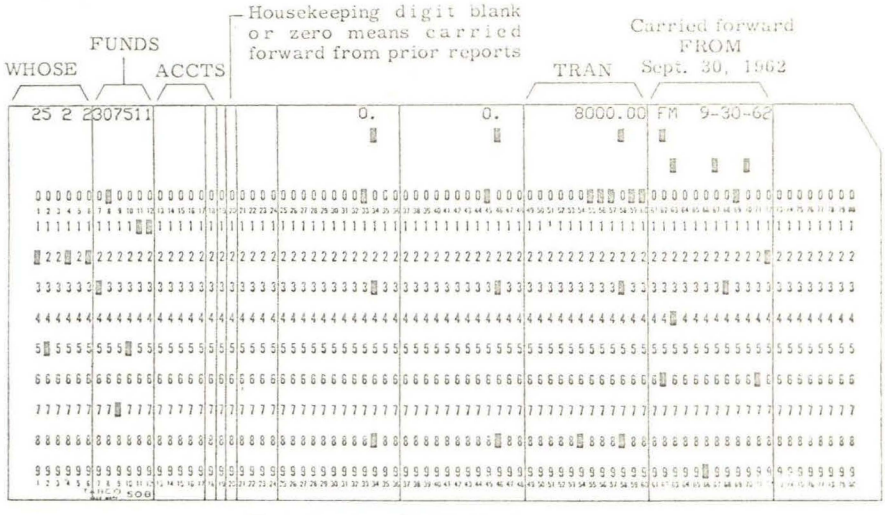
CONTROL CARD

(precedes all data cards)



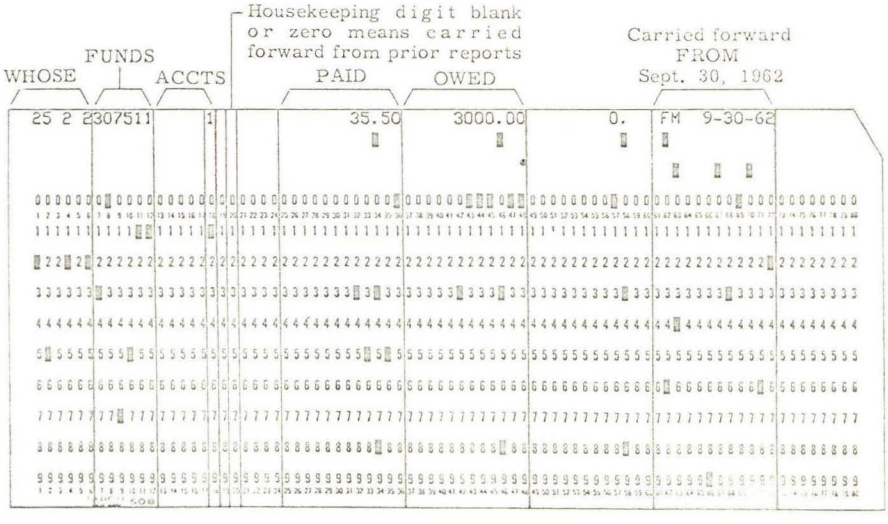
CARRIED FORWARD CARD FOR TRANSFERS

(ordinarily punched as part of output of previous report)

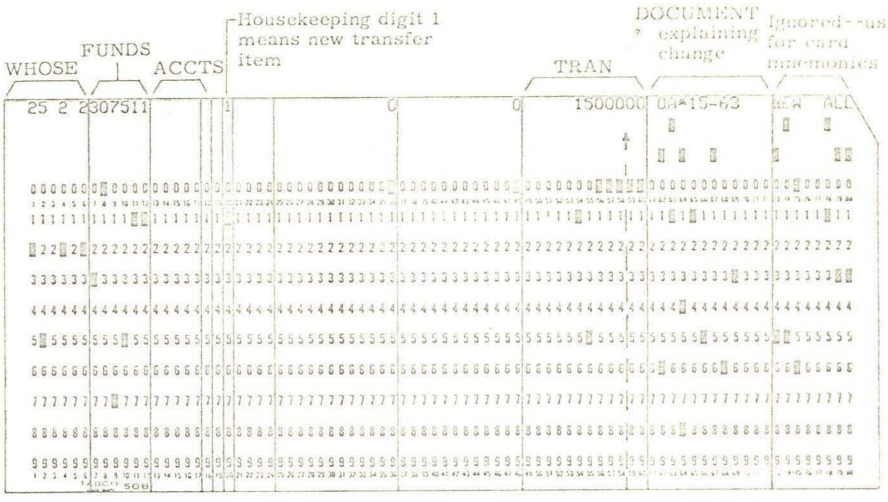


CARRIED FORWARD CARD FOR PAID, OWED

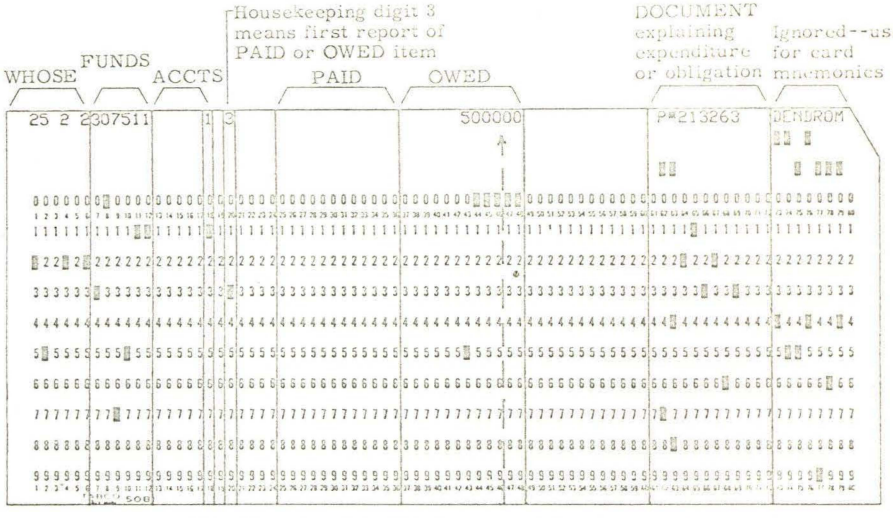
(ordinarily punched as part of output of previous report)



CHANGE IN ALLOTMENT OR TRANSFER OF FUNDS

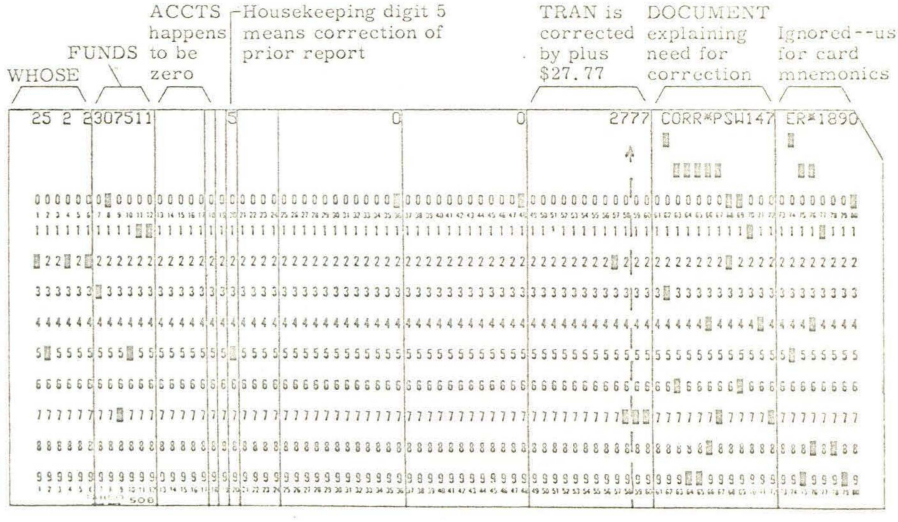


EXPENDITURE (PAID OR OWED)



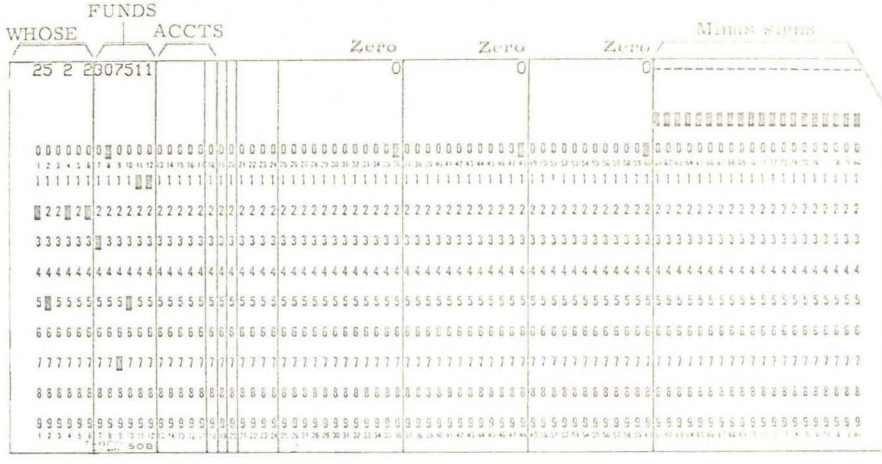
CORRECTION CARD FOR PAID, OWED, TRAN

(needed to correct errors occurring in prior reports)



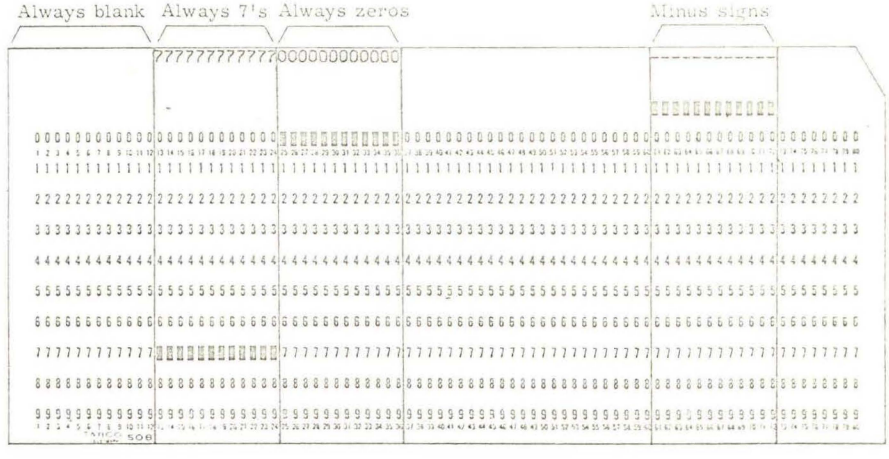
SEPARATOR
OR
HEADER
CARD

(to separate different WHOSE; carries same FUNDS ACCTS as first occur for a given WHOSE)



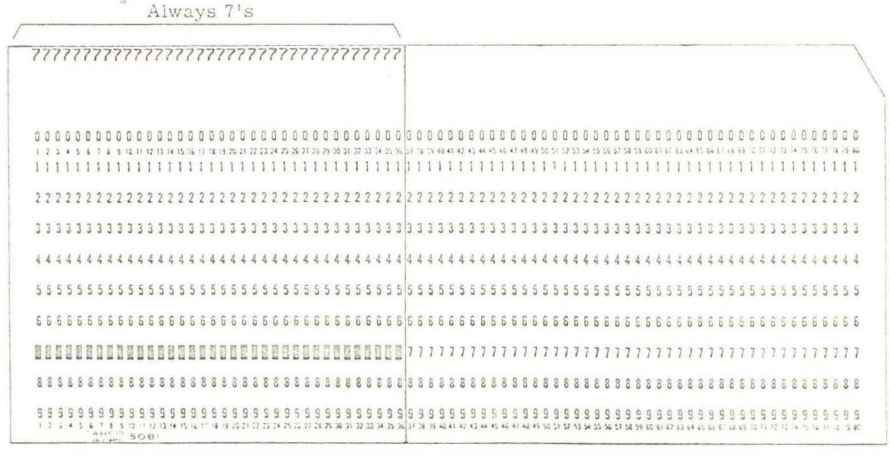
END OF
SINGLE
REPORT

(terminates each separate individual report)



LAST CARD

(end of all reports; follows card shown above when last report has been input)



APPENDIX 3

FORTRAN and FAP Programs Effecting Instant Octal Accounting

on IBM 7090 Computer (FORTRAN Monitor)

```
*      FORTRAN
CBCACT    PSWFES RESEARCH ACCOUNTING PROGRAM BY L.R.GROSENBAUGH          BCACT000
     0DIMENSION DECK(28000),ARA(7,4000),ARB(7,4000),PAID(7,4000),        BCACT001
     1OWED(7,4000),TRAN(7,4000),DOCA(7,4000),DOCB(7,4000),AKEY(7),       BCACT002
     2BKEY (7),ALFATH (6)                                                BCACT003
      COMMON DECK,ARA,ARB,PAID,OWED,TRAN,DOCA,DOCB,ARRR,ACCT,LL          BCACT004
     0EQUIVALENCE (DECK(7),ARA(7),ARB(6),PAID(5),OWED(4),TRAN(3),        BCACT005
     1DOCA(2),DOCB(1))                                                   BCACT006
    1 FORMAT  (I4,6A6,A6,A2,XX,4X,I6)                                    BCACT007
    20FORMAT (4H1    ,6A6,A6,A2,X,XX,I6,I6,6H PAGE ,I3/1X5HWHOSE,X5HFUNDSBCACT008
    21X5HACCTS, 13X4HPAID8X4HOWED8X4HTRAN2X12HBAL,SUB,DOC*//)            BCACT009
    3 FORMAT (2012,3F12.2,2A6)                                           BCACT010
    4 FORMAT (X,2012,3F12.2,2A6)                                         BCACT011
    5 FORMAT (X,012,  06,6X,3F12.2,2A6)                                  BCACT012
    6 FORMAT (X,012,  06,6X,3F12.2,4H TO ,A6,A2)                         BCACT013
    7 FORMAT (012,  06,6X,3F12.2,4H FM ,A6,A2)                           BCACT014
    8 FORMAT (43X,18H ACCOUNT SUBTOTAL ,F12.2//)                         BCACT015
    9 FORMAT   (X,012,13X,A6,A2,27H ALLOTTEE FUNDFUNC BALANCE ,F12.2//)  BCACT016
   10 FORMAT  (13HOPRIOR SUMS ,12X,3F12.2)                               BCACT017
   11 FORMAT (13H TOTAL SUMS ,A6,A2,4X,3F12.2)                           BCACT018
   12 FORMAT  (13H FINAL BAL. ,A6,A2,28X,F12.2,12H END OF RUN )          BCACT019
   18 JPAGE =1                                                           BCACT020
      J=0                                                                BCACT021
      READ  1,JEND,(ALFATH(I),I=1,6),JDAT,JYR,NT                         BCACT022
      IF (JEND)  19,20 ,19                                               BCACT023
   19 CALL EXIT                                                          BCACT024
   20 J=J+1                                                              BCACT025
     OREAD  3, ARA(1,J),ARB(1,J),PAID(1,J),OWED(1,J),TRAN(1,J),          BCACT026
     1DOCA(1,J),DOCB(1,J)                                                BCACT027
      IF (ARA(1,J)) 20,21,20                                             BCACT028
   21 NP=J-1                                                             BCACT029
      NC=XSIGNF(NP,NT)                                                   BCACT030
B     TM=377777777777                                                    BCACT031
      DO 22 I=1,7                                                        BCACT032
      AKEY (I)=0.0                                                       BCACT033
   22 BKEY (I)=0.0                                                       BCACT034
      AKEY (1)=1.0                                                       BCACT035
      AKEY (2)=1.0                                                       BCACT036
      AKEY (3)=-0.0                                                      BCACT037
      AKEY (4)=TM                                                        BCACT038
      BKEY (3)=TM                                                        BCACT039
      BKEY (5)=1.0                                                       BCACT040
      CALL SORTAC (DECK,NC,7,AKEY,BKEY)                                  BCACT041
   30 PRINT 2,(ALFATH(I),I=1,6),JDAT,JYR,   NT,NP,JPAGE                  BCACT042
      L3=3                                                               BCACT043
      JPAGE=JPAGE+1                                                      BCACT044
      PAIDR=0.0                                                          BCACT045
      OWEDR=0.0                                                          BCACT046
      TRANR=0.0                                                          BCACT047
      SUBT =0.0                                                          BCACT048
      BALA =0.0                                                          BCACT049
      PCHO =0.0                                                          BCACT050
      PCHN =0.0                                                          BCACT051
      OCHO =0.0                                                          BCACT052
      OCHN =0.0                                                          BCACT053
      TCHO =0.0                                                          BCACT054
```

```
      TCHN =0.0                                                          BCACT055
      BCHN =0.0                                                          BCACT056
   31 DO 900 J=1,NP                                                      BCACT057
      PAIDR=PAIDR+PAID(1,J)                                              BCACT058
      OWEDR=OWEDR+OWED(1,J)                                              BCACT059
      TRANR=TRANR+TRAN(1,J)                                              BCACT060
      SUBT =TRANR-PAIDR-OWEDR                                            BCACT061
      PCHN =PCHN+PAID(1,J)                                               BCACT062
      OCHN =OCHN+OWED(1,J)                                               BCACT063
      TCHN =TCHN+TRAN(1,J)                                               BCACT064
      ARRR =ARA(1,J)                                                     BCACT065
      LL=XTBF(J)                                                         BCACT066
      GO TO (100,200,300,400,500,600,700,800),LL                         BCACT067
   41 PRINT 2,(ALFATH(I),I=1,6),JDAT,JYR,    NT,NP,JPAGE                BCACT068
      L3=3                                                               BCACT069
      JPAGE=JPAGE+1                                                      BCACT070
   42 PCHO =PCHO+PAID(1,J)                                               BCACT071
      OCHO =OCHO+OWED(1,J)                                               BCACT072
      TCHO =TCHO+TRAN(1,J)                                               BCACT073
      PRINT 5,ARRR,ACCT,PAIDR,OWEDR,TRANR,DOCA(1,J),DOCB(1,J)            BCACT074
      L3=L3+1                                                            BCACT075
      GO TO N,(101,102,201,202,203,301,302,401,402,403,501,601,602,801)  BCACT076
   44 PRINT 6,ARRR,ACCT,PAIDR,OWEDR,TRANR,JDAT,JYR                       BCACT077
      PUNCH 7,ARRR,ACCT,PAIDR,OWEDR,TRANR,JDAT,JYR                       BCACT078
      PRINT 8,SUBT                                                       BCACT079
      L3=L3+3                                                            BCACT080
      BALA =BALA+SUBT                                                    BCACT081
      PAIDR=0.0                                                          BCACT082
      OWEDR=0.0                                                          BCACT083
      TRANR=0.0                                                          BCACT084
      SUBT =0.0                                                          BCACT085
      GO TO N,(101,102,201,202,203,301,302,401,402,403,501,601,602,801)  BCACT086
   46 PRINT 9,ARRR,JDAT,JYR,BALA                                         BCACT087
      L3=L3+2                                                            BCACT088
      BCHN =BCHN+BALA                                                    BCACT089
      BALA =0.0                                                          BCACT090
      GO TO N,(101,102,201,202,203,301,302,401,402,403,501,601,602,801)  BCACT091
  100 ASSIGN 101 TO N                                                    BCACT092
      GO TO 44                                                           BCACT093
  101 ASSIGN 102 TO N                                                    BCACT094
      GO TO 46                                                           BCACT095
  102 GO TO 900                                                          BCACT096
  200 ASSIGN 201 TO N                                                    BCACT097
      IF (50-L3) 41,41,42                                                BCACT098
  201 ASSIGN 202 TO N                                                    BCACT099
      GO TO 44                                                           BCACT100
  202 ASSIGN 203 TO N                                                    BCACT101
      GO TO 46                                                           BCACT102
  203 GO TO 900                                                          BCACT103
  300 ASSIGN 301 TO N                                                    BCACT104
      GO TO 44                                                           BCACT105
  301 ASSIGN 302 TO N                                                    BCACT106
      GO TO 46                                                           BCACT107
  302 GO TO 900                                                          BCACT108
  400 ASSIGN 401 TO N                                                    BCACT109
      IF (50-L3) 41,41,42                                                BCACT110
```

```
401 ASSIGN 402 TO N                                                    BCACT111
    GO TO 44                                                           BCACT112
402 ASSIGN 403 TO N                                                    BCACT113
    GO TO 46                                                           BCACT114
405 GO TO 900                                                          BCACT115
500 ASSIGN 501 TO N                                                    BCACT116
    GO TO 44                                                           BCACT117
501 GO TO 900                                                          BCACT118
600 ASSIGN 601 TO N                                                    BCACT119
    IF (50-L3) 41,41,42                                                BCACT120
601 ASSIGN 602 TO N                                                    BCACT121
    GO TO 44                                                           BCACT122
602 GO TO 900                                                          BCACT123
700 GO TO 900                                                          BCACT124
800 ASSIGN 801 TO N                                                    BCACT125
    IF (50-L3) 41,41,42                                                BCACT126
801 GO TO 900                                                          BCACT127
900 CONTINUE                                                           BCACT128
901 PRINT 2,(ALPATH(I),I=1,6),JDAT,JYR,    NT,NP,JPAGE                 BCACT129
   0PRINT 4,(ARA(1,J),ARB(1,J),PAID(1,J),OWED(1,J),TRAN(1,J),          BCACT130
   1DOCA(1,J),DOCB(1,J),J=1,NP)                                        BCACT131
    PRINT 10,PCHO,OCHO,TCHO                                            BCACT132
    PRINT 11,JDAT,JYR,PCHN,OCHN,TCHN                                   BCACT133
    PRINT 12,JDAT,JYR,BCHN                                             BCACT134
    GO TO 18                                                           BCACT135
    END                                                                BCACT136
```

```
*     FAP                                                                    BCXTB000
      LBL     BCXTB,2                                                        BCXTB001
      COUNT   100                                                            BCXTB002
*     FUNCTION XTB(J) TO ANALYZE TAB ACTION FOR ARRAYED ITEMS                BCXTB003
*     BY L.R.GROSENBAUGH                                                     BCXTB004
      ENTRY   XTB                                                            BCXTB005
XTB   SXD     XTB-2,4                                                        BCXTB006
      LRS     53                                                             BCXTB007
      MPY     DDD                                                            BCXTB008
      LLS     35                                                             BCXTB009
      SUB     DDD                                                            BCXTB010
      ADD     KDECK                                                          BCXTB011
      ADD     D                                                              BCXTB012
      STA     MOST                                                           BCXTB013
      STA     ALL                                                            BCXTB014
      ADD     DD                                                             BCXTB015
      STA     LAST-1                                                         BCXTB016
      STA     LAST+1                                                         BCXTB017
      ADD     D                                                              BCXTB018
      STA     MOST+1                                                         BCXTB019
      STZ     LL                                                             BCXTB020
      AXT     0,4                                                            BCXTB021
      CAL     ARRR                                                           BCXTB022
      NZT     **                                                             BCXTB023
LAST  TRA     ALL                                                            BCXTB024
      ERA     **                                                             BCXTB025
      TNZ     MAJOR                                                          BCXTB026
      TRA     MOST                                                           BCXTB027
MAJOR TXI     ALL,4,2                                                        BCXTB028
MINOR TXI     ALL,4,4                                                        BCXTB029
SAME  TXI     ALL,4,6                                                        BCXTB030
MOST  LDI     **                                                             BCXTB031
      IIS     **                                                             BCXTB032
      LFT     777777                                                         BCXTB033
      TRA     MINOR                                                          BCXTB034
      TRA     SAME                                                           BCXTB035
ALL   LDQ     **                                                             BCXTB036
      PXA     0,0                                                            BCXTB037
      LGL     18                                                             BCXTB038
      STO     ACCT                                                           BCXTB039
      RQL     5                                                              BCXTB040
      TQP     *+4                                                            BCXTB041
      TXI     *+1,4,1                                                        BCXTB042
      PXD     0,4                                                            BCXTB043
      TRA     OUT                                                            BCXTB044
      TXI     *+1,4,2                                                        BCXTB045
      PXD     0,4                                                            BCXTB046
OUT   LXD     XTB-2,4                                                        BCXTB047
      TRA     1,4                                                            BCXTB048
*                 CONSTANTS                                                  BCXTB049
D     OCT     -1                                                             BCXTB050
DD    OCT     -6                                                             BCXTB051
DDD   OCT     -7                                                             BCXTB052
*                 ERASABLES                                                  BCXTB053
KDECK           DECK                                                         BCXTB054
*                 COMMON                                                     BCXTB055
DECK  COMMON    28006                                                        BCXTB056
ARRR  COMMON    1                                                            BCXTB057
ACCT  COMMON    1                                                            BCXTB058
LL    COMMON    1                                                            BCXTB059
      END
```

PROGRAM BC ACT ALSO REQUIRES REASSEMBLY OF FAP SUBROUTINE WD SORT (SHARE M1-WD SORT,SHARE DISTRIBUTION NUMBER 1249,BY D.MOORE WITH REASSEMBLY AFTER CHANGING CARD NO. SORT0442 TO 'MAXA EQU 217').